

PATENT ABSTRACTS OF JAPAN

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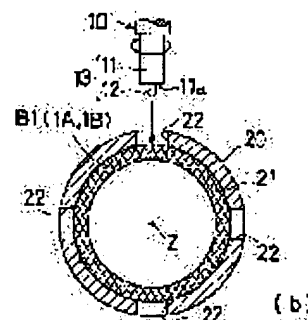
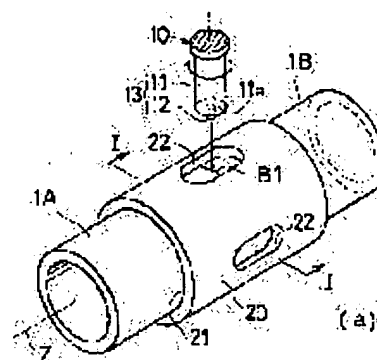
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(54) METHOD OF FRICTION STIR JOINING

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method of a friction stir by which a part to be joined is excellently joined with a high efficiency of the joining work.

SOLUTION: The method of the friction stir joining is for joining a part B1 to be joined extending in the peripheral direction of joining members 1A and 1B having a cylindrical form. The joining members 1A and 1B are freely rotatably inserted into the hollow part 21 of a restricting sleeve 20. Thus the joining members 1A and 1B are so restricted that the sectional form of the joining members is not deformed. A joining head 13 of a joining tool 10 is inserted into the part B1 to be joined through an insertion port 22 for the joining head provided at the intermediate part in the axial direction of the peripheral wall of the restricting sleeve 20. Under this state, the part B1 to be joined is joined by turning the joining members 1A and 1B so that the part B1 to be joined passes in succession under the joining head 13, or turning the joining head 13 and the restricting sleeve 20 as one body so that the joining head 13 passes on the part to be joined B1.



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the operation gestalt of this invention (claim 1), and the perspective view showing the condition that (a) inserted joint material into the centrum of a sleeve, and (b) are the I-I line sectional views in (a).

[Drawing 2] The perspective view in which (a) shows the condition in the middle of junction, and (b) are the II-II line sectional views in (a).

[Drawing 3] It is drawing showing one operation gestalt which will be accepted invention (claim 2), and the perspective view showing this condition that (a) inserted joint material into the centrum of a sleeve, and (b) are the III-III line sectional views in (a).

[Drawing 4] The perspective view in which (a) shows the condition in the middle of junction, and (b) are the IV-IV line sectional views in (a).

[Drawing 5] It is drawing of this invention (claim 1) showing another operation gestalt further, and is drawing of longitudinal section showing the condition in the middle of junction.

[Drawing 6] It is drawing for explaining the fault of the conventional friction churning conjugation method, and the perspective view showing the condition before (a) inserts the junction head of a junction tool in the matching section, and (b) are the perspective views showing the condition after inserting the junction head of a junction tool in the matching section.

[Drawing 7] It is drawing for explaining the conventional friction churning conjugation method, and is the perspective view showing the condition of having inserted the core in the centrum of joint material and having carried out support reinforcement of the matching section.

[Drawing 8] It is drawing for explaining the conventional friction churning conjugation method, and is the perspective view showing the condition of having carried out fitting of the fitting heights to the edge opening circles of joint material, and having carried out support reinforcement of the matching section.

[Description of Notations]

1A, 1B;2;3A, 3B -- Joint material

10 -- Junction tool

13 -- Junction head

20 -- Restricted sleeve

21 -- Centrum

22 -- Junction head push-in hole

B1 -- Matching section (junction schedule section prolonged in the hoop direction)

B-2 -- Matching section (the direction of an axis, and junction schedule section prolonged in parallel)

L -- Superposition section (junction schedule section prolonged in the hoop direction)

W -- Joint

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] About the friction churning conjugation method to which this invention joins the joint material of the shape of tubed thru/or a cylinder, this friction churning conjugation method is suitably applied, in case for example, metal hollow pipe material is joined together.

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PRIOR ART

[Description of the Prior Art] Since it is a kind of solid state welding, the friction churning junction which carries out the junction unification of the two joint material has the advantage of being hard to produce the deformation and the crack by heat distortion, and has been used in recent years as a new junction means replaced with melting welding (for example, MIG, TIG, laser welding) or low attachment.

[0003] Drawing 6 (a) shows the case where the matching section (B) which compared the edges of the joint material (51A) (51B) of the two shape of a cylinder of the isomorphism said ** is joined by friction churning junction.

[0004] In this drawing, (60) is a junction tool for friction churning junction. This junction tool (60) is equipped with the junction head (63) which consists of a pin-like probe (62) of **** which protruded on the end-face (61a) axis of the cylindrical rotator (61) of path size, and this rotator (61). In joining the matching section (B) using this junction tool (60), while inserting this probe (62) in the matching section (B) by forcing that tip on the front face of the matching section (B), rotating a rotator (61) and rotating a probe (62), the end face (61a) of a rotator (61) is forced on the front face of the matching section (B). Joint material (51A) (51B) is rotated focusing on that axis (z') so that the matching section (B) may pass a sequential junction head (63) in this condition. And by things Or by moving a junction head (63) to the hoop direction of joint material (51A) (51B) along with the matching section (B) so that a junction head (63) may pass the matching section (B) The perimeter is covered, it is joined, the matching section (B) has, and both joint material (51A) (51B) is unified.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the friction churning conjugation method to which this invention joins the joint material of the shape of tubed thru/or a cylinder, this friction churning conjugation method is suitably applied, in case for example, metal hollow pipe material is joined together.

[0002]

[Description of the Prior Art] Since it is a kind of solid state welding, the friction churning junction which carries out the junction unification of the two joint material has the advantage of being hard to produce the deformation and the crack by heat distortion, and has been used in recent years as a new junction means replaced with melting welding (for example, MIG, TIG, laser welding) or low attachment.

[0003] Drawing 6 (a) shows the case where the matching section (B) which compared the edges of the joint material (51A) (51B) of the two shape of a cylinder of the isomorphism said ** is joined by friction churning junction.

[0004] In this drawing, (60) is a junction tool for friction churning junction. This junction tool (60) is equipped with the junction head (63) which consists of a pin-like probe (62) of **** which protruded on the end-face (61a) axis of the cylindrical rotator (61) of path size, and this rotator (61). In joining the matching section (B) using this junction tool (60), while inserting this probe (62) in the matching section (B) by forcing that tip on the front face of the matching section (B), rotating a rotator (61) and rotating a probe (62), the end face (61a) of a rotator (61) is forced on the front face of the matching section (B). Joint material (51A) (51B) is rotated focusing on that axis (z') so that the matching section (B) may pass a sequential junction head (63) in this condition. And by things Or by moving a junction head (63) to the hoop direction of joint material (51A) (51B) along with the matching section (B) so that a junction head (63) may pass the matching section (B) The perimeter is covered, it is joined, the matching section (B) has, and both joint material (51A) (51B) is unified.

[0005]

[Problem(s) to be Solved by the Invention] However, since this joint material (51A) (51B) is a cylinder-like thing, if the tip of a probe (62) is forced on the front face of the matching section (B) Or if the end face (61a) of a rotator (61) is further forced on the front face of the matching section (B), as shown in this drawing (b) In response to the holding-down pressure of this junction head (63), joint material (51A) (51B) deforms in the shape of abbreviation flat in the matching section (B). When putting in another way, it was able to deform so that the cross-section configuration in the matching section (B) of joint material (51A) (51B) might become ellipse-like, and for this reason, the matching section (B) could not be joined good, and the high junction article of dimensional accuracy was not able to be obtained.

[0006] Then, in order to prevent deformation of the joint material (51A) (51B) by the holding-down pressure of a junction head (63) the voice over [as shown in drawing 7 R> 7 / in the centrum of joint material (51A) (51B)] the matching section (B) for a cylinder-like core (70) -- it is made like, and inserts and carrying out support reinforcement of the matching section (B) from the rear face by this is

proposed.

[0007] However, by this proposal approach, since the core (70) remained in the centrum of joint material (51A) (51B), there was a difficulty that the weight of the junction article obtained becomes heavy. Or since the activity for removing a core (70) again was required, working capacity was bad.

[0008] Moreover, in order to prevent deformation of the joint material (51A) (51B) by the holding-down pressure of a junction head (63) As shown in drawing 8, the joint material (52) of the solid which replaces with the joint material (51B) of the shape of one cylinder, and has fitting heights (52a) is used. Carrying out fitting of the fitting heights (52a) of this joint material (52) to the edge opening circles of the joint material (51A) of another side, and carrying out support reinforcement of the matching section (B) from that rear face by this is proposed.

[0009] However, since the thing of a solid was similarly used as joint material (52) by this proposal approach, there was a difficulty that the weight of a junction article becomes heavy.

[0010] Furthermore, by the two above-mentioned proposal approaches, in order that rear-face supporters, such as a core (70) and fitting heights (52a), might fix to the joint formed in the matching section (B) by each, a possibility that a root crack might occur from an interface with a reinforcement member was in the joint, for this reason, junction actuation had to be performed carefully, and junction working capacity was bad.

[0011] This invention was not made based on the above technical backgrounds, and even if that purpose does not carry out support reinforcement of the junction schedule section with rear-face supporters, such as a core and fitting heights, it is to be able to join the junction schedule section good and offer the high friction churning conjugation method of junction working capacity.

[0012]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention (claim 1) While inserting joint material into the centrum of the restricted sleeve which is the friction churning conjugation method which joins the junction schedule section prolonged in the hoop direction of cylinder-like joint material, and restrains joint material in the deformation inhibition condition of a cross-section configuration, enabling free rotation The junction head of a junction tool is inserted in the junction schedule section through the junction head push-in hole in which it was prepared in the direction pars intermedia of an axis of the peripheral wall section of a restricted sleeve. In this condition It is characterized by joining the junction schedule section rotating joint material so that the junction schedule section may pass a sequential junction head, or by making one rotate a junction head and a restricted sleeve so that a junction head may pass the junction schedule section.

[0013] According to this friction churning conjugation method, by inserting joint material into the centrum of a restricted sleeve, it is restrained so that this joint material may not deform and a cross-section configuration may not deform by the restricted sleeve, and deformation of the cross-section configuration of the joint material by the holding-down pressure of a junction head is prevented. And the junction schedule section is joined by making the above rotate joint material like, or rotating a junction head and a restricted sleeve as mentioned above. Since it faces joining this junction schedule section, and deformation of the cross-section configuration of the joint material by the holding-down pressure of a junction head is prevented by the restricted sleeve as mentioned above, the junction schedule section can be joined good and the high junction article of dimensional accuracy can be obtained. Moreover, since it is not necessary to use rear-face supporters, such as a core and fitting heights, as the conventional example showed, the increment in weight of a junction article does not arise and junction working capacity improves.

[0014] Moreover, this invention (claim 2) is a friction churning conjugation method which joins the direction of an axis of tubed joint material, and the junction schedule section prolonged in parallel. While inserting joint material free [migration in the direction of an axis] into the centrum of the restricted sleeve which restrains joint material in the deformation inhibition condition of a cross-section configuration The junction head of a junction tool is inserted in the junction schedule section through the junction head push-in hole in which it was prepared in the direction pars intermedia of an axis of the peripheral wall section of a restricted sleeve. In this condition It is characterized by joining the junction

schedule section moving joint material so that the junction schedule section may pass a sequential junction head, or by moving a junction head and a restricted sleeve to one so that a junction head may pass the junction schedule section.

[0015] This friction churning conjugation method also does the same operation as the above so.

[0016]

[Embodiment of the Invention] Next, the operation gestalt of this invention is explained with reference to a drawing.

[0017] Drawing 1 and drawing 2 show the 1st operation gestalt of this invention (claim 1).

[0018] drawing 1 (a) -- setting (1(1A) B) -- it is the joint material of the two shape of a cylinder of the isomorphism said ** mutually. Each joint material (1A) (1B) will be a metal thing, and if it explains in full detail, it will be a thing made from aluminum or its alloy. The edge where each joint material (1A) (1B) is compared is formed so that the flat surface containing the end face may intersect perpendicularly to an axis (z). and the voice which makes the axes (z) of the edge [the edge of one joint material (1A), and] of the joint material (1B) of another side of each joint material correspond -- it is made like and compared. (B1) is the matching section which comes to compare the edges of joint material (1A) (1B), and supports the junction schedule section to which this matching section (B1) extended in the hoop direction of joint material with this operation gestalt.

[0019] In this drawing, (10) is a junction tool for friction churning junction. This junction tool (10) is equipped with the junction head (13) which consists of a pin-like probe (12) of **** which protruded on the end-face (11a) axis of the cylindrical rotator (11) of path size, and this rotator (11). The heights for softened zone churning (not shown) are prepared in the peripheral surface of said probe (12).

[0020] In this drawing, (20) is a restricted cylinder-like sleeve. This restricted sleeve (20) has rigidity higher than joint material (1A) (1B), and has the centrum (21) of the cross-section circle configuration penetrated in the direction of an axis. The bore of this restricted sleeve (20) is set as the outer diameter and this ** of joint material (1A) (1B), or is set as large ** more slightly than the outer diameter of joint material (1A) (1B). By this It is in the condition that are constituted so that it can insert exactly, and joint material (1A) (1B) was inserted into the centrum (21). this restricted sleeve (20) -- the inside of that centrum (21) -- joint material (1A) (1B) -- abbreviation -- It is constituted so that deformation of the cross-section configuration of the joint material (1A) (1B) produced with the holding-down pressure of a junction head (13) can be prevented. Furthermore, this restricted sleeve (20) is in the condition that joint material (1A) (1B) was inserted into the centrum (21) by setting up that bore as mentioned above. It is constituted so that this joint material (1A) (1B) can be held free [rotation] focusing on the axis (z), and it is constituted so that this joint material (1A) (1A) can be held free [migration in the direction of the axis (z)].

[0021] Furthermore, together with the hoop direction, penetration formation of the junction head push-in hole (22) of the shape of an ellipse [two or more (this drawing four pieces)] is carried out in the direction (die-length direction) pars intermedia of an axis of the peripheral wall section of this restricted sleeve (20). The path of each junction head push-in hole (22) is set as large ** a little rather than the path of the edge of the rotator (11) of a junction head (13).

[0022] Next, the procedure which joins the matching section (B1) using the above-mentioned restricted sleeve (20) is explained.

[0023] First, joint material (1A) (1B) is inserted from edge opening of this restricted sleeve (20) into the centrum (21) of a restricted sleeve (20), and as shown in drawing 1 (a) and (b), the edges of this joint material (1A) (1B) are compared so that the matching section (B1) may come to the location of a junction head push-in hole (22). Or since the edges of two joint material (1A) (1B) are compared beforehand, a restricted sleeve (20) may be moved so that joint material (1A) (1B) may be inserted into a centrum (21).

[0024] In the condition that joint material (1A) (1B) was inserted into the centrum (21) of a restricted sleeve (20), a restricted sleeve (20) makes the matching section (B1) a **** mode, and is arranged, and the inner skin of a restricted sleeve (20) covered the abbreviation perimeter, and is further in contact with the peripheral face of joint material (1A) (1B). In this way, joint material (1A) (1B) is restrained by

the deformation inhibition condition of a cross-section configuration by the restricted sleeve (20). Moreover, the axis (z) of joint material (1A) (1B) is carrying out abbreviation coincidence with the axis of a restricted sleeve (20). Furthermore, in this condition, by the restricted sleeve (20), joint material (1A) (1B) is held free [rotation] focusing on the axis (z), and is held still freer [migration in the direction of an axis (z)].

[0025] Subsequently, rotating the rotator (11) of a junction tool (10) and rotating a probe (12), a junction head (13) is inserted in a junction head push-in hole (22), and the tip of a probe (12) is forced on the front face of the matching section (B1). If the tip of a probe (12) contacts the front face of the matching section (B1), this contact section will force the end face (11a) of a rotator (11) on the front face of the matching section (B1) while it moves a probe (12) further and inserts this probe (12) in the matching section (B1), since it softens with frictional heat. By forcing the end face (11a) of a rotator (11) on the front face of the matching section (B1), scattering of the softened zone softened with frictional heat can be prevented, the good joint (W) of a junction condition can be formed now, and a joint (W) without irregularity can be formed now in a front face.

[0026] in the case of insertion in the matching section (B1) of this junction head (13), joint material (1A) (1B) will deform in the shape of abbreviation flat in the matching section (B1) in response to the holding-down pressure of a junction head (13), although carried out As mentioned above, since joint material (1A) (1B) is restrained so that a cross-section configuration may not deform by the restricted sleeve (20), even if it receives the holding-down pressure of a junction head (13), joint material (1A) (1B) does not deform in the matching section (B1), but the cross-section configuration is held circularly.

[0027] In this condition, as shown in drawing 2 (a) and (b), the location of a restricted sleeve (20) and a junction head (13) is fixed. Joint material (1A) (1B) is rotated within the centrum (21) of a restricted sleeve (20) focusing on the axis (z) of this joint material (1A) (1B) so that the matching section (B1) may pass a probe (12) one by one (hand-of-cut I). Or joint material (1A) (1B) is fixed, and one is made to rotate a restricted sleeve (20) and a junction head (13) focusing on the axis (z) of joint material (1A) (1B) so that a probe (12) may pass the matching section (B1). With this 1st operation gestalt, junction actuation on [of explanation] expedient is performed on the former operating instructions. In addition, in this invention, junction actuation may be performed combining both junction actuation.

[0028] With then, the frictional heat generated by rotation of a probe (12) or the frictional heat further generated with sliding with the end face (11a) of a rotator (11), and the front face of the matching section (B1) While softening the contact section or near [its] the probe (12) and agitating this softened zone in response to the turning effort of a probe (12), after this softening churning section carries out plastic flow in the mode which fills the passage slot on the probe (12), frictional heat is lost quickly and cooling solidification is carried out. This phenomenon is successively repeated with rotation of joint material (1A) (1B), finally, that perimeter is covered, it is joined (joint W), the matching section (B1) has, and both joint material (1A) (1B) is unified.

[0029] The butt joint article which draws out and takes out joint material (1A) (1B), and has and asks for it out of the centrum (21) of a restricted sleeve (20) is obtained after junction termination.

[0030] Since junction actuation was performed where the cross-section configuration in the matching section (B1) of joint material (1A) (1B) is held circularly, the matching section (B1) has passed the junction head (13) smoothly, for this reason, the junction condition of a joint (W) is good, and this butt joint article has close dimensional accuracy.

[0031] Moreover, since rear-face supporters which showed the matching section (B1) to the joint (W) in the conventional example for carrying out support reinforcement from that rear face, such as a core and fitting heights, have not fixed, there is no possibility that a root crack may occur in a joint (W), for this reason, junction actuation can be performed quickly, and junction working capacity is high. From the first, since the rear-face supporter has not fixed, the increment in weight has not produced this butt joint article.

[0032] Drawing 3 and drawing 4 show the 2nd operation gestalt of this invention (claim 2). Hereafter, this 2nd operation gestalt is explained focusing on a difference with the above-mentioned 1st operation

gestalt.

[0033] In drawing 3 (a), (2) is cylinder-like joint material. This joint material (2) is formed in the shape of a cylinder by rounding off the Taira plate which has constant width, and comparing crosswise edges. The matching section (B-2) of edges is prolonged in parallel with the direction of an axis of joint material (2). With this 2nd operation gestalt, this matching section (B-2) supports the direction of an axis of joint material, and the junction schedule section prolonged in parallel.

[0034] In addition, a restricted sleeve (20) and a junction tool (10) are the same configurations as the thing of the above-mentioned 1st operation gestalt.

[0035] Next, the procedure which joins the matching section (B-2) using a restricted sleeve (20) is explained.

[0036] First, cylinder-like joint material (2) is inserted from edge opening of this restricted sleeve (20) into the centrum (21) of a restricted sleeve (20).

[0037] In the condition that joint material (2) was inserted into the centrum (21) of a restricted sleeve (20), joint material (2) is held free [migration in the direction of the axis (z)], and is held still freer [rotation centering on the axis (z)]. Moreover, the inner skin of a restricted sleeve (20) covered the abbreviation perimeter, and is in contact with the peripheral face of joint material (2). In this way, joint material (2) is restrained by the deformation inhibition condition of a cross-section configuration by the restricted sleeve (20).

[0038] Subsequently, while inserting the probe (12) of a junction tool (10) in the matching section (B-2) through a junction head push-in hole (22), the end face (11a) of a rotator (11) is forced on the front face of the matching section (B-2). Even if it receives the holding-down pressure of this junction head (13), since joint material (2) is restrained so that a cross-section configuration may not deform by the restricted sleeve (20), the fault which joint material (2) deforms in the shape of abbreviation flat in the matching section (B-2) is not produced, but that cross-section configuration is held circularly.

[0039] In this condition, as shown in drawing 4 (a) and (b), the location of a restricted sleeve (20) and a junction head (13) is fixed, and joint material (2) is moved in the direction of an axis within the centrum (21) of a restricted sleeve (20) so that the matching section (B-2) may pass a probe (12) one by one (migration direction RO). Or a restricted sleeve (20) and a junction head (13) are moved to one in parallel with the direction of an axis (z) of joint material (1A) (1B) so that a probe (12) may pass the matching section (B-2). With this 2nd operation gestalt, junction actuation on [of explanation] expedient is performed on the former operating instructions. In addition, in this invention, junction actuation may be performed combining both junction actuation.

[0040] With then, the frictional heat generated by rotation of a probe (12) or the frictional heat further generated with sliding with the end face (11a) of a rotator (11), and the front face of the matching section (B-2) While softening the contact section or near [its] the probe (12) and agitating this softened zone in response to the turning effort of a probe (12), after this softening churning section carries out plastic flow in the mode which fills the passage slot on the probe (12), frictional heat is lost quickly and cooling solidification is carried out. This phenomenon is successively repeated with migration of joint material (2), finally, that overall length is covered, it is joined (joint W), the matching section (B-2) has in it, and joint material (2) is formed in the shape of a cylinder.

[0041] The junction article which draws out and takes out joint material (3), and has and asks for it out of the centrum (21) of a restricted sleeve (20) is obtained after junction termination.

[0042] It has the advantage as the above-mentioned 1st operation gestalt also with this same 2nd operation gestalt.

[0043] Drawing 5 shows the 3rd operation gestalt of this invention (claim 1). Hereafter, this 3rd operation gestalt is explained focusing on a difference with the above-mentioned 1st operation gestalt.

[0044] With this 3rd operation gestalt, the edge of the joint material (3A [say / the following and 1st joint material]) of the shape of one cylinder is inserted in the edge opening circles of the joint material (3B [say / the following and 2nd joint material]) of the shape of a cylinder of another side. The case where the superposition section (L) of the edge of the 1st joint material (3A) and the edge of the 2nd joint material (3B) is joined is shown. Therefore, with this 3rd operation gestalt, the superposition

section (L) of edges supports the junction schedule section prolonged in the hoop direction of joint material (3A) (3B).

[0045] On the other hand, the restricted sleeve (20) is constituted as follows.

[0046] The bore of the left end section (20a) of a restricted sleeve (20) It is set as the outer diameter and this ** of the 1st joint material (3A), or is set as large ** more slightly than the outer diameter of the 1st joint material (3A). By this the left end section (20a) of this restricted sleeve (20) -- the inside of that centrum (21a) -- the 1st joint material (3A) -- abbreviation -- it is constituted so that it can insert exactly. On the other hand, the bore of the right end section (20b) of a restricted sleeve (20) It is set as the outer diameter and this ** of the 2nd joint material (3B), or is set as large ** more slightly than the outer diameter of the 2nd joint material (3B). By this the right end section (20b) of this restricted sleeve (20) -- the inside of that centrum (21b) -- the 2nd joint material (3B) -- abbreviation -- it is constituted so that it can insert exactly. Other configurations are the same as the restricted sleeve of the above-mentioned 1st operation gestalt.

[0047] Next, the procedure which joins the superposition section (L) using a restricted sleeve (20) is explained.

[0048] First, the 1st joint material (3A) is inserted from left end section opening of this restricted sleeve (20) into the centrum (21a) of the left end section (20a) of a restricted sleeve (20). Moreover, the 2nd joint material (3B) is inserted from right end section opening of this restricted sleeve (20) into the centrum (21b) of the right end section (20b) of a restricted sleeve (20). And the edge of the 1st joint material (3A) is inserted in the edge opening circles of the 2nd joint material (3B), and the superposition section (L) is formed.

[0049] In the condition that joint material (3A) (3B) was inserted into the centrum (21) of a restricted sleeve (20), each joint material (3A) (3B) is held free [rotation] focusing on the axis (z). Moreover, the inner skin of a restricted sleeve (20) covered the abbreviation perimeter, and is in contact with the peripheral face of each joint material (3A) (3B). In this way, each joint material (3A) (3B) is restrained by the deformation inhibition condition of a cross-section configuration by the restricted sleeve (20).

[0050] Subsequently, while inserting the probe (12) of a junction tool (10) in the superposition section (L) through a junction head push-in hole (22), the end face (11a) of a rotator (11) is forced on the front face of the superposition section (L).

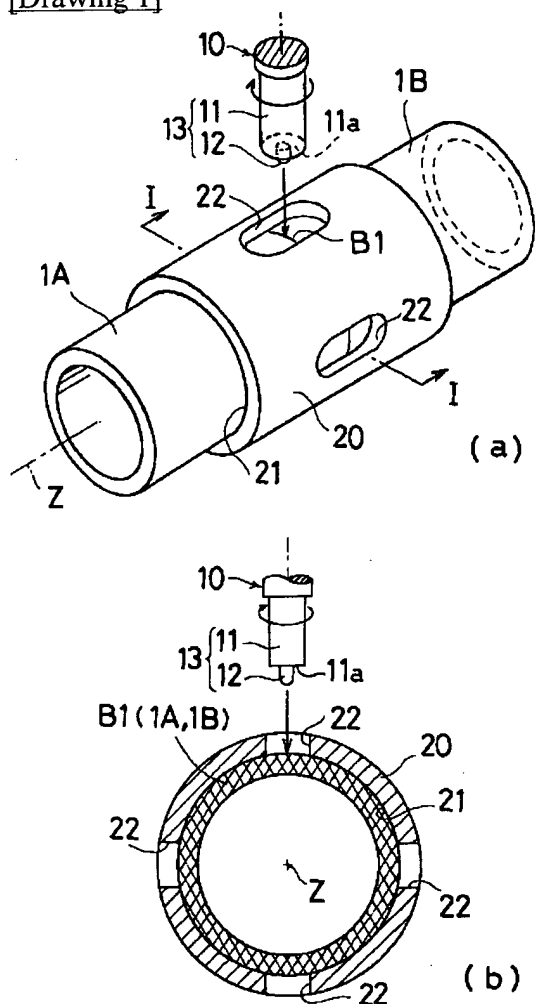
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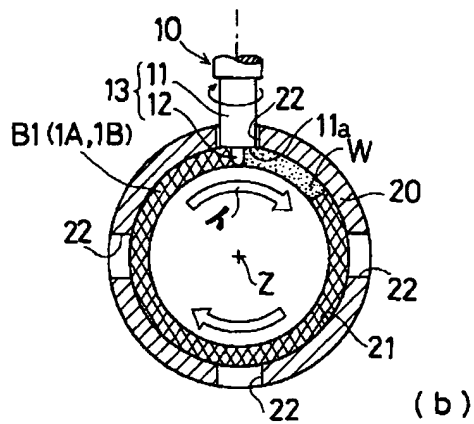
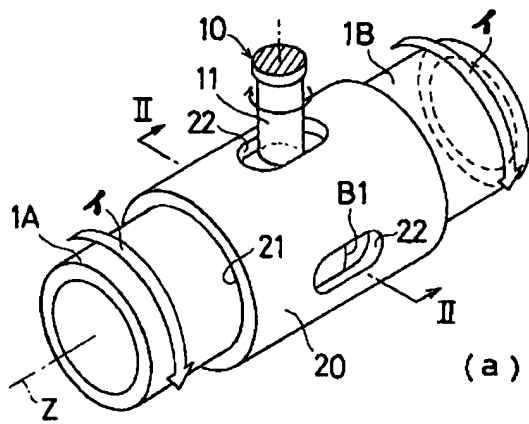
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

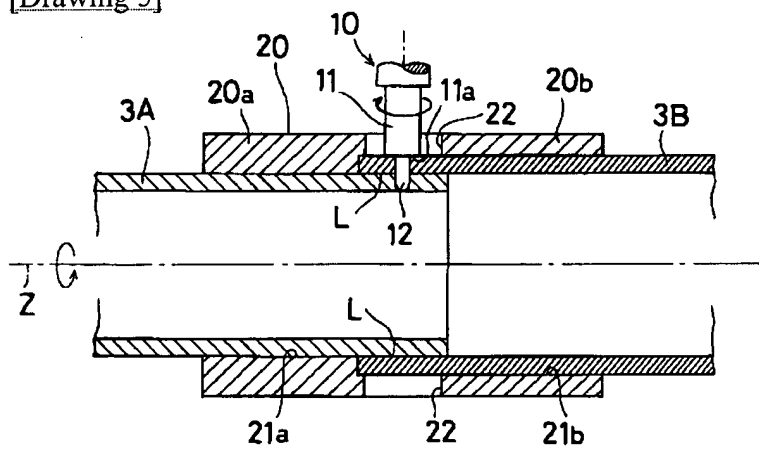
[Drawing 1]



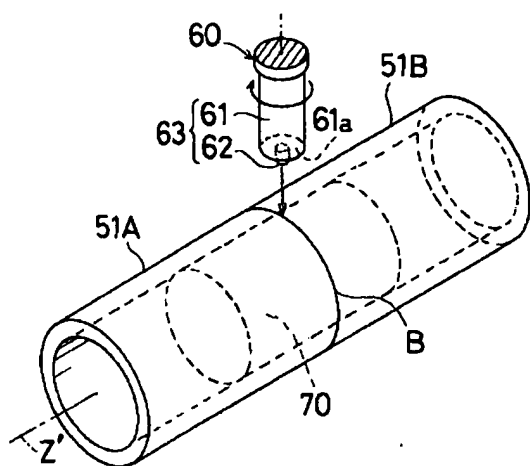
[Drawing 2]



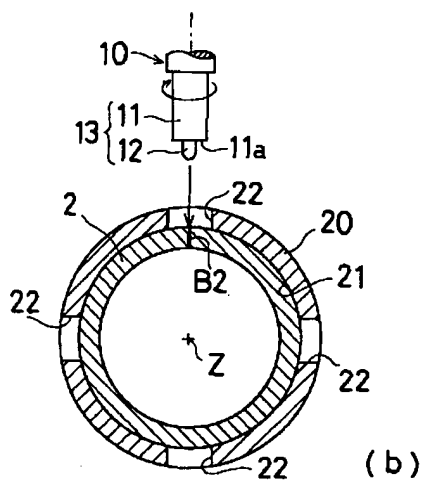
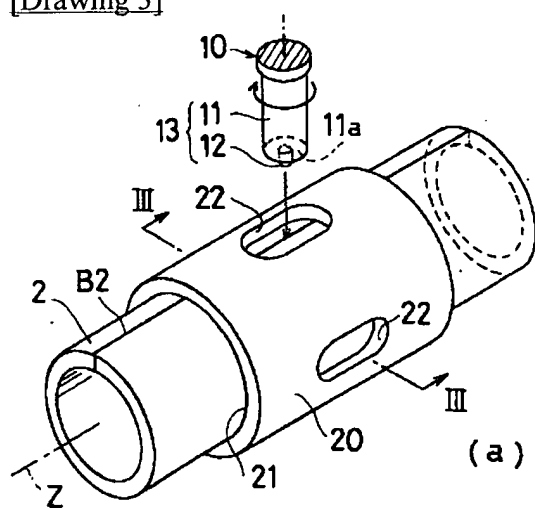
[Drawing 5]



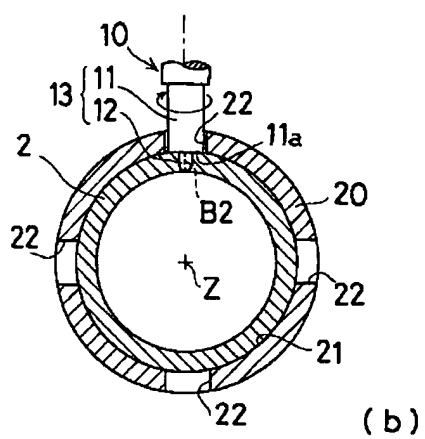
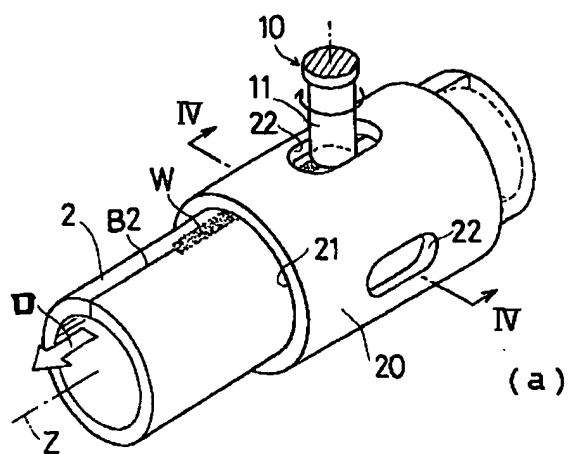
[Drawing 7]



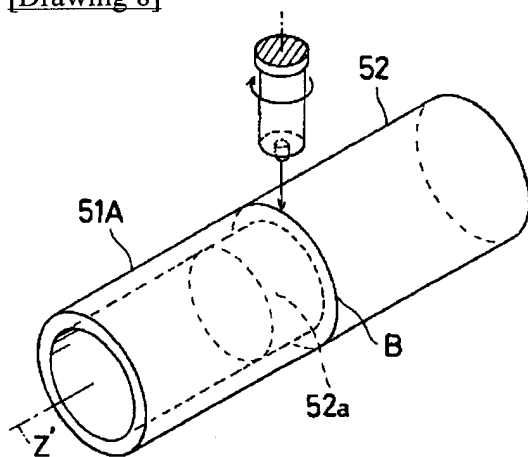
[Drawing 3]



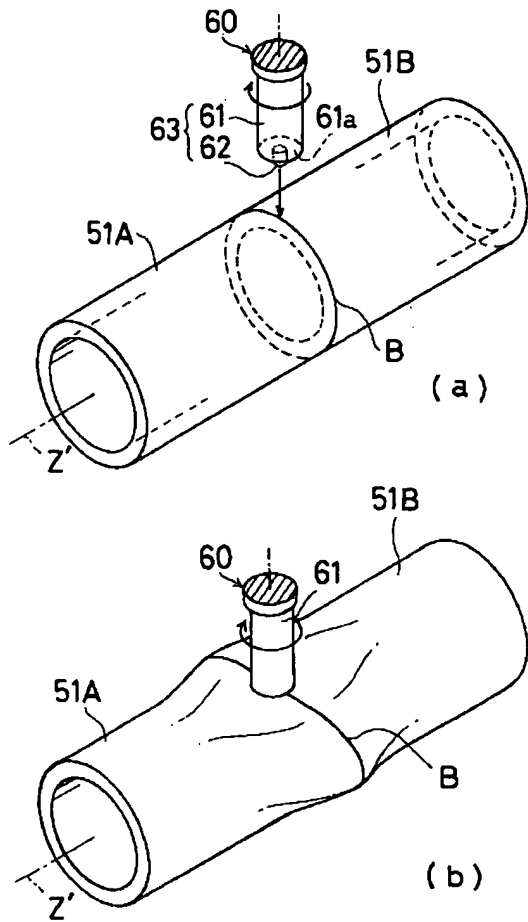
[Drawing 4]



[Drawing 8]



[Drawing 6]



[Translation done.]